

**Taxonomic study of the adult and immature stages of the clearwing moth, *Synanthedon haitangvora* Yang (Lepidoptera, Sesiidae), injurious to apple trees in Korea**

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**Abstract** Damage by a clearwing moth, *Synanthedon haitangvora* Yang, to apple trees, *Malus pumila* var. *dulcissima* Koidzumi, is described from Korea. Adult, genitalia, and immature stages are illustrated. The biology is briefly summarized.

**Key words** Lepidoptera, Sesiidae, larva, pupa, genitalia, *Synanthedon haitangvora*, Korea.

The family Sesiidae has a worldwide distribution comprising about 1,000 described species in over 400 genera (Heppner, 1991). However, scientific information and systematic study of the family Sesiidae from Korea have been limited to simple description or records, relationships within the family have not been studied in detail, nor has it been properly revised. Recently, Arita *et al.*, (2004) reviewed the Korean Sesiidae, producing an important checklist, but morphological study has been poor in substance except on the species *Synanthedon bicingulata* (Staudinger) (Lee *et al.*, 2004). The family can be defined by a combination of the following characters (Špatenka *et al.*, 1999): forewing often partly transparent, hindwing mostly transparent throughout; imagines mimicking Hymenoptera and Diptera, abdomen often with yellow, orange, red or white rings, bands or segmental margins; M-stem of forewing venation lost; M-stem of hindwing shifted towards costal vein; larvae endophagous, non-pigmented, with slightly enlarged thoracic segments; larval ocelli I–IV arranged to form a quadrangle, ocelli V and VI slightly separated; abdominal segments 3–6 of pupa with 2 distinct rows of spines dorsally; antennal sheaths of pupa broadening distally.

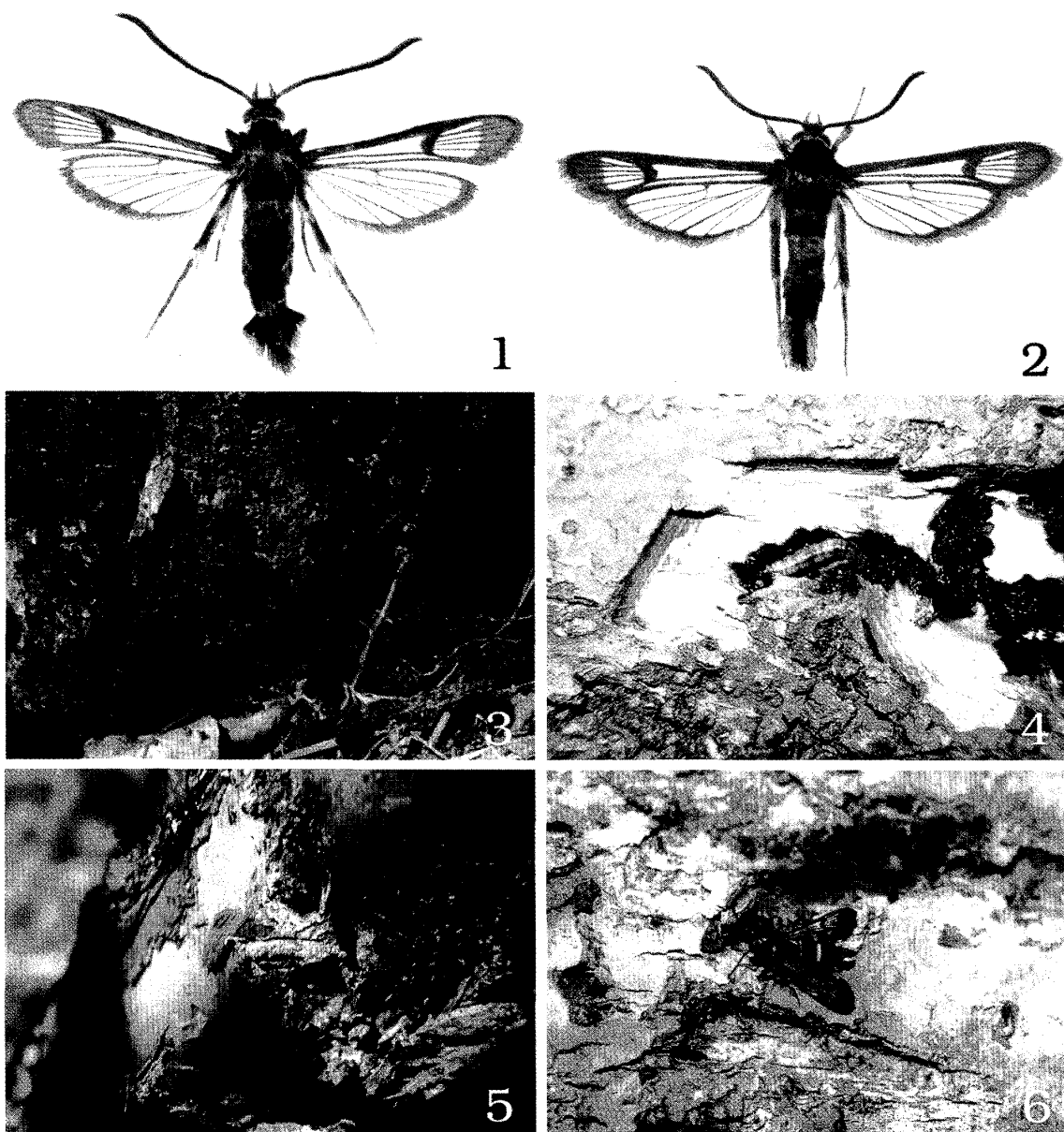
In the present study, the adult and immature stages of a little known species, *Synanthedon haitangvora* Yang, 1977, injurious to the apple tree, *Malus pumila* var. *dulcissima* Koidzumi, are described. The wing venation, genitalia of the adult, and the immature stages are described and illustrated. The biology is briefly summarized.

**Materials and methods**

Most of the specimens of adult and immature stages examined in this study were collected at an apple farm, Igok-ri, Kapyeong-gun, Korea between May 28 and June 3, 1999. Male and female genitalia were dissected after being macerated for 4–6 min in 10% KOH heated in a double waterbath. The larvae were reared in plastic cups for 1–4 weeks in the laboratory in nearly natural conditions. Three to five specimens of the larval and pupal stages are examined in this study respectively.

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Figs 1–6. *Synanthedon haitangvora* Yang. 1. Male adult. 2. Female adult. 3. Scarred bark with large quantities of sawdust-like frass expelled by larva, trunk of *Malus pumila* var. *dulcissima* Koidzumi. 4. The mature larva in tunnel, exposed. 5. Cocoon constructed of rounded sawdust. 6. Freshly emerged adult.

***Synanthedon haitangvora* Yang, 1977 (Figs 1–14)**

*Synanthedon haitangvora* Yang, 1977, *Moths of North China* 1: 123, pl. 4: 7, 8. TL: China (Beijing).

*Synanthedon unocingulata* Bartel: Špatenka *et al.*, 1999: 140, pl 16, fig. 117, text-figs 85 (♂), 347 (♀), text-figures of male and female genitalia were misidentified as *S. haitangvora*.

**Adult (Figs 1–2, 6)**

Wingspan 18.5–24.0 mm; body length 9.0–13.5 mm; forewing 8.0–10.5 mm; antenna 6.0–7.3 mm.

Head. Antenna entirely dark brown to black with dark purple sheen; scape dark brown with

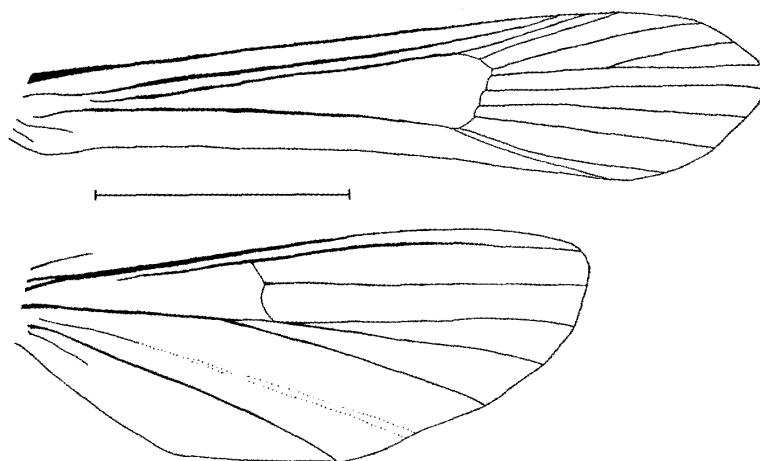


Fig. 7. *Synanthedon haitangvora* Yang, wing venation. Scale bar=3.5 mm.

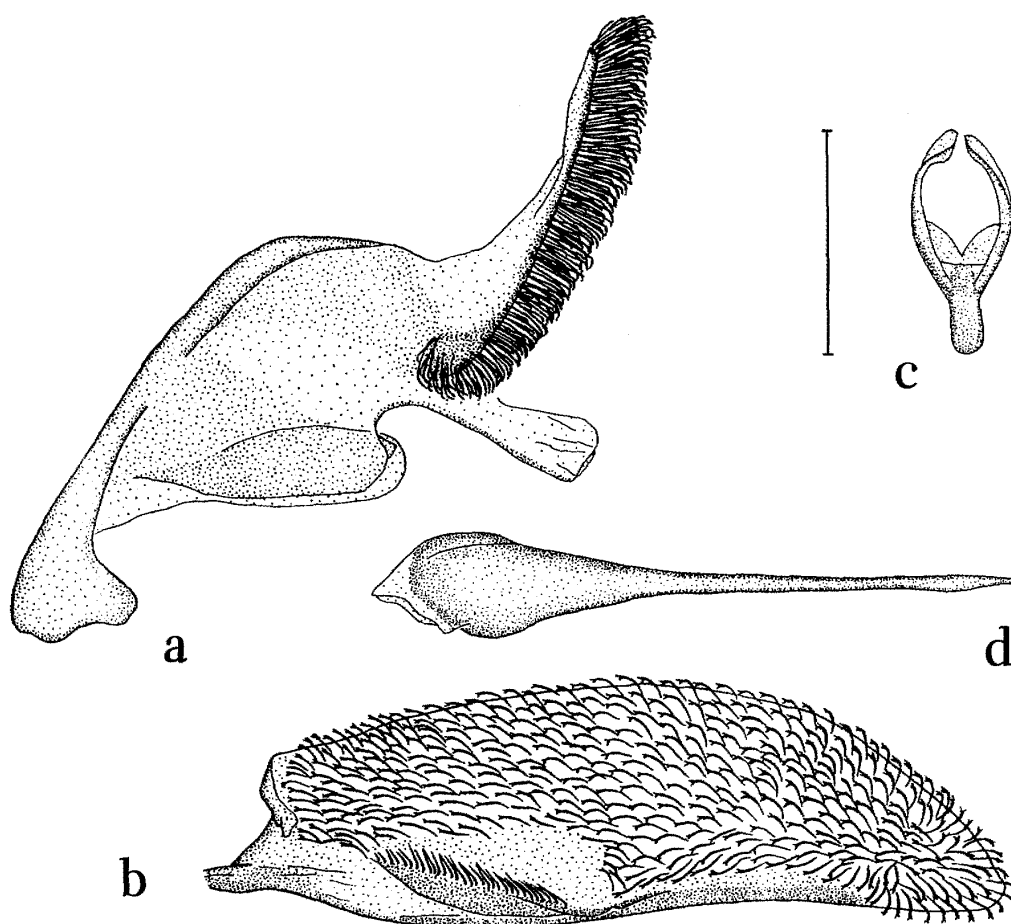


Fig. 8. Male genitalia of *Synanthedon haitangvora* Yang (genital preparation No. UIB-5519) (a: tegumen-uncus complex; b: valva; c: saccus; d: aedeagus). Scale bar=0.7 mm.

purple sheen; frons dark gray-brown with purple-blue sheen, narrowly white laterally; labial palpus exterior-dorsally dark brown to black with purple sheen, interior-ventrally pale yellow with a few white scales basally; vertex dark brown to black with strong purple-blue sheen; occipital fringe dorsally yellow-orange with a few black scales, laterally pale yellow

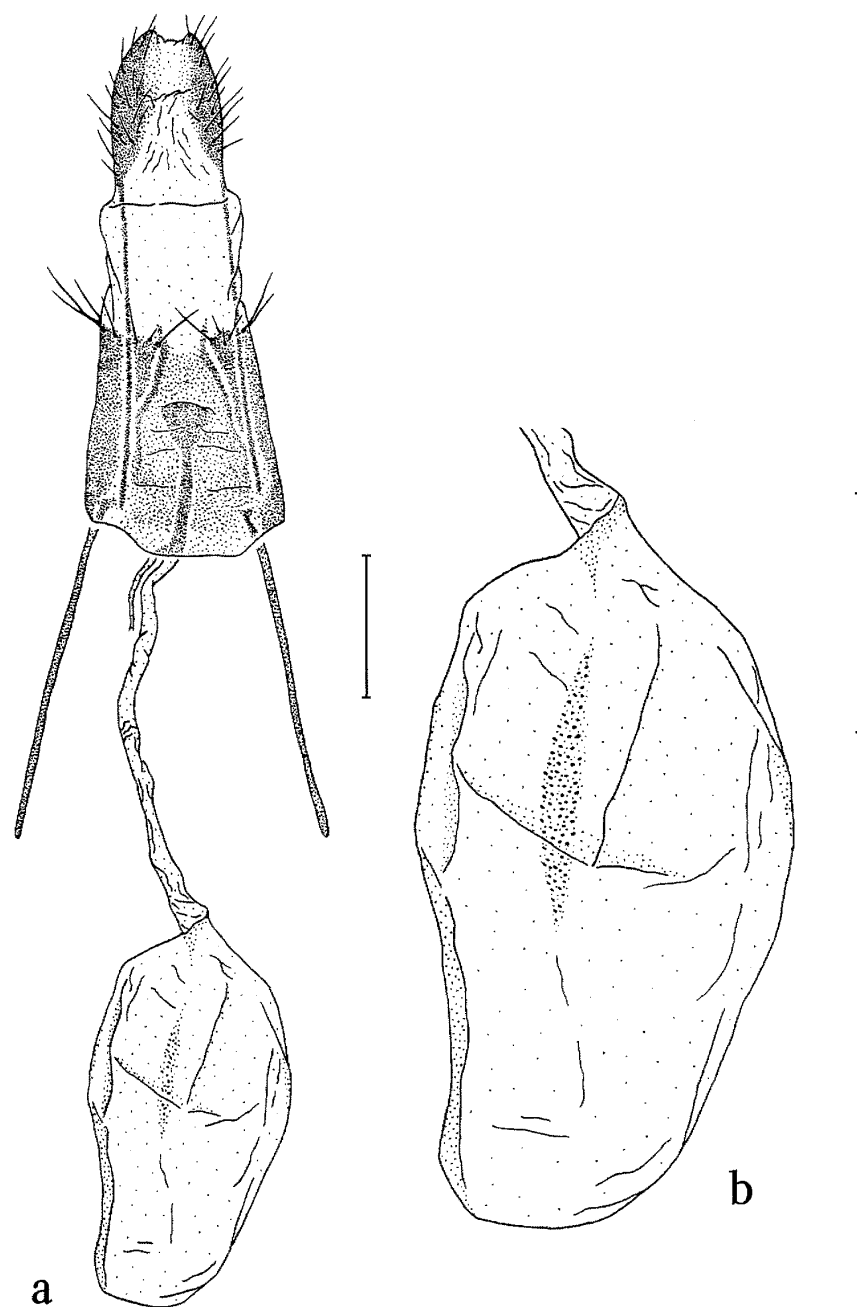


Fig. 9. Female genitalia of *Synanthedon haitangvora* Yang (genital preparation No. UIB-5518).  
Scale bar=0.5 mm.

to white.

**Thorax.** Patagia dark brown to black with purple-bronzed sheen; tegula dark brown to black with bronzed-purple sheen; mesothorax dark brown to black with dark-bronzed sheen, with a tuft of black and a few white hairs laterally; thorax laterally dark brown to black with strong bronzed-blue sheen, with a large pale yellow spot; posteriorly metepimeron and metameron dark brown to black with purple-blue sheen, with admixture of a few white scales on metepimeron, covered with white setaceous scales.

**Legs.** Neck plate dark brown to black with strong purple-blue sheen, with admixture of

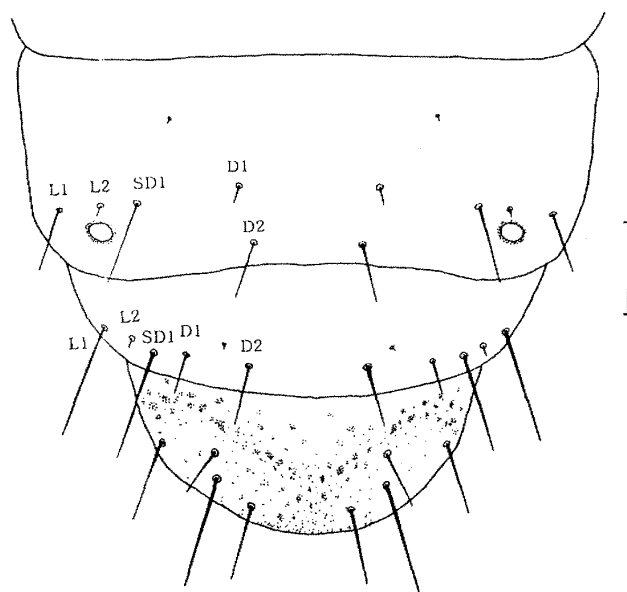


Fig. 10. *Synanthedon haitangvora* Yang. Dorsal view of eighth to tenth abdominal segments of larva. Scale bar=0.5 mm.

white scales laterally; fore coxa dark brown to black with purple-bronzed sheen, with a narrow and short pale yellow stripe with golden sheen exterior-basally; fore femur entirely dark brown to black with bronzed-violet sheen; fore tibia dark brown to black bronzed, with admixture of pale yellow scales ventrally; fore tarsus dorsally dark brown to black with bronzed-violet sheen, ventrally gray-brown with bronzed sheen; mid coxa dark brown with bronzed-blue sheen; mid femur dark brown with bronzed-blue sheen; mid tibia dark brown to black with bronzed-blue sheen, with an elongated ochreous stripe exterior-medially and with a tuft of pointed pale yellow-orange scales dorso-distally; spurs dark brown to black with bronzed purple sheen; mid tarsus exterior-dorsally dark brown to black with bronzed-purple sheen; hind coxa dark brown with bronzed-blue sheen; hind femur dark brown with bronzed-blue sheen, with admixture of ochreous scales internally; hind tibia externally dark brown to black with bronzed-blue sheen, with a small ochreous spot at base of medial spurs and with a few pointed ochreous scales dorso-distally, internally in basal half ochreous with golden sheen and in proximal half dark brown to black with bronzed-violet sheen; spurs dark brown with bronzed-purple sheen externally and ochreous with golden sheen internally; hind tarsus dark brown to black with strong purple-blue sheen, with admixture of ochreous scales exterior-ventrally.

**Abdomen.** Dorsally dark brown to black with dark purple sheen; tergite 2 with narrow yellow-orange stripe latero-distally; tergite 4 with a broad, slightly laterally broadened, orange stripe distally; ventrally dark brown to black with purple-blue sheen; sternite 4 with a broad yellow-orange stripe distally, sternite 5 with admixture of yellow-orange scales medially; anal tuft dark brown to black with dark purple sheen, dorsally densely mixed with two yellow-orange longitudinal stripes.

**Forewing.** Basally black with blue sheen; costal margin dark brown to black with purple-blue sheen; CuA-stem and anal margin dark brown to black with purple sheen; discal spot black with dark purple sheen; veins within external transparent area and apical area dark brown to black with dark purple sheen; discal spot narrow, slightly broadened medially; transparent areas well-developed; external transparent area large divided into five cells,

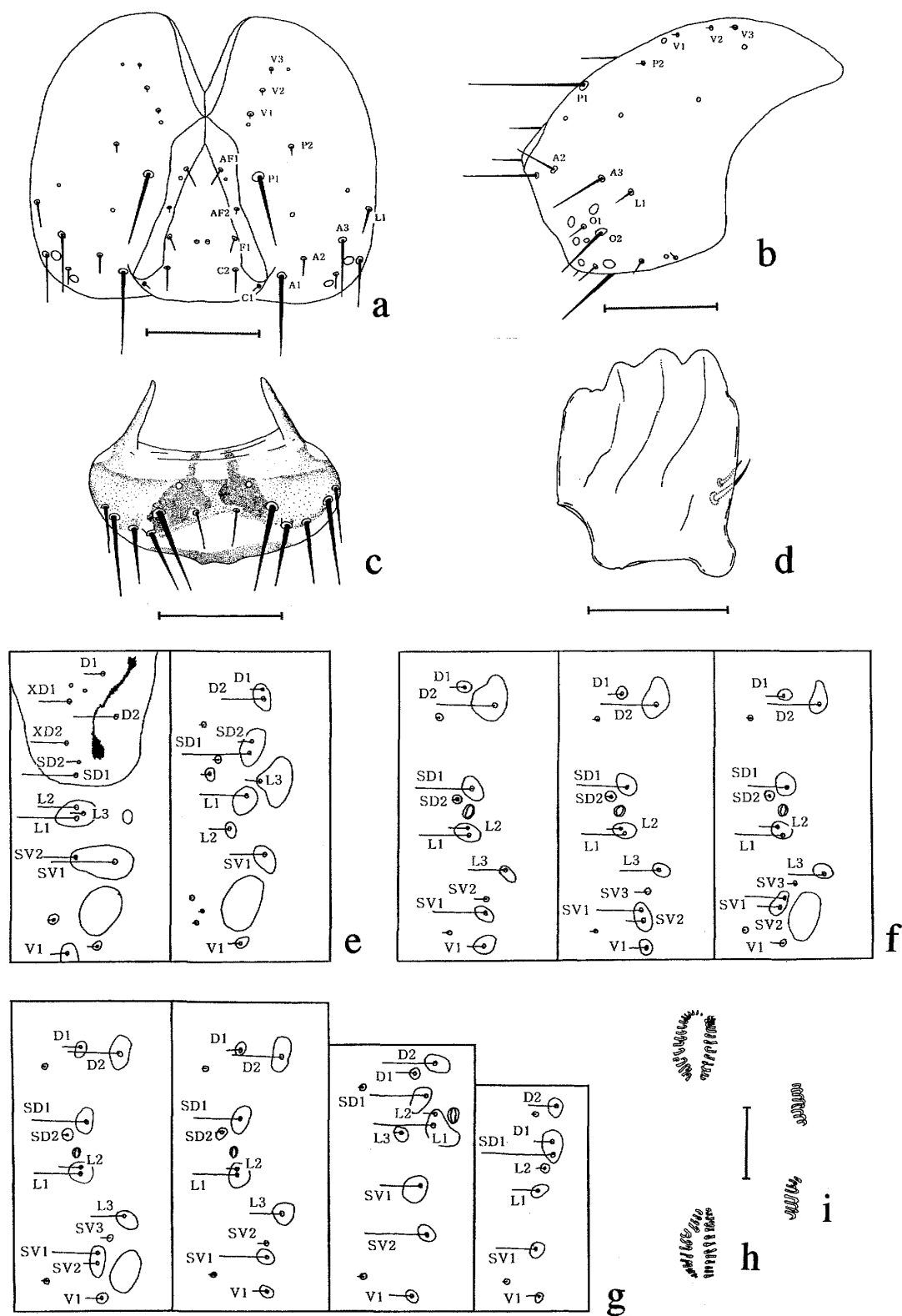
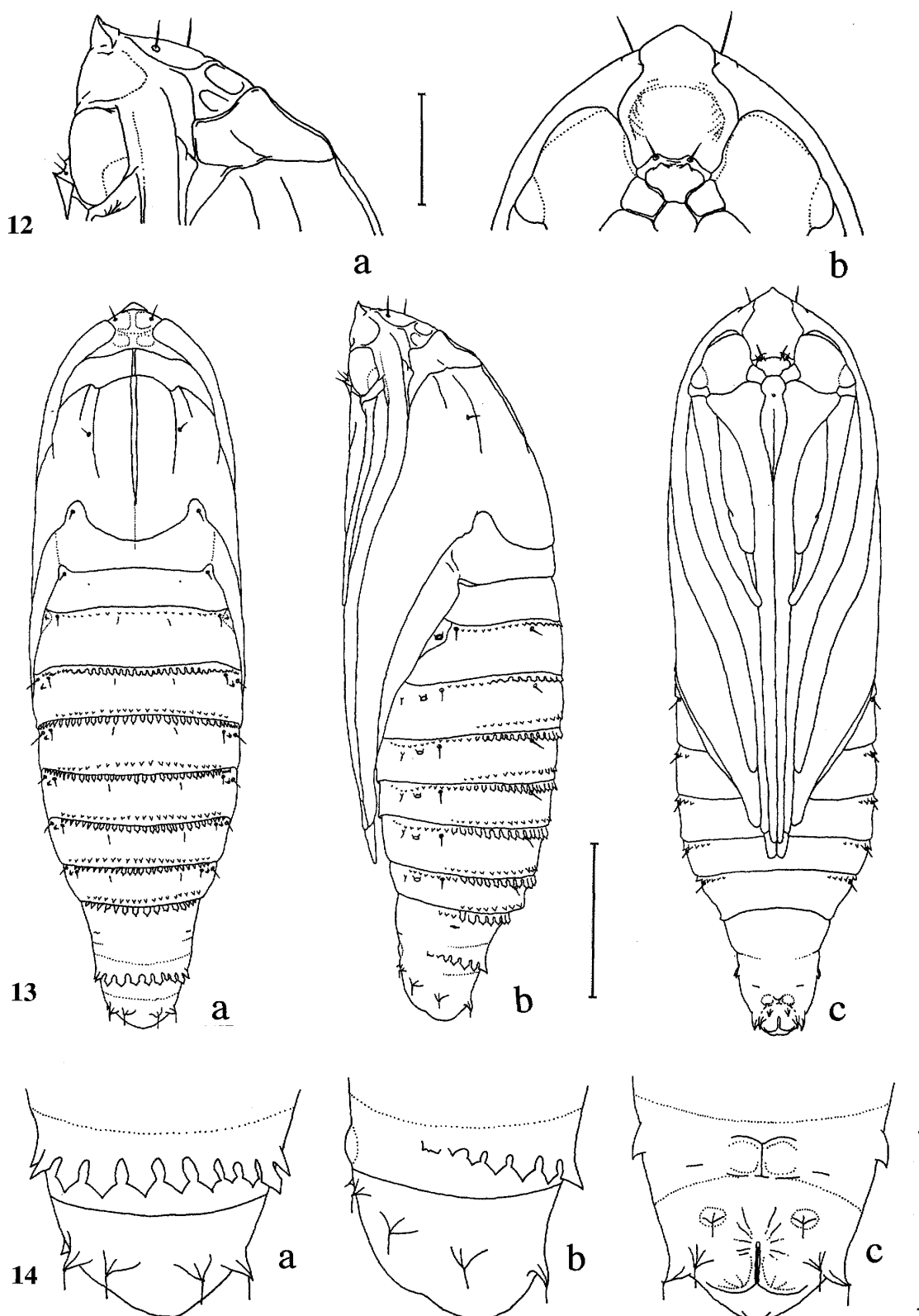


Fig. 11. *Synanthedon haitangvora* Yang (a: head, dorsal view; b: oceller region, left side; c: labrum, dorsal view; d: mandible, ventral view; e: pro- and mesothorax; f: first to 3rd abdominal segments; g: sixth to 9th abdominal segments; h: third abdominal proleg, ventral view; i: anal proleg, ventral view). Scale bars: 1.0 mm for a & b; 0.3 mm for c & d; 0.5 mm for h & i.



Figs 12–14. *Synanthedon haitangvora* Yang, ex *Malus pumila* var. *dulcissima* Koidzumi, pupa, male. 12. Pupal frontal process (a: lateral view; b: dorsal view). 13. Total aspect (a: dorsal view; b: lateral view; c: ventral view). 14. Spines of tenth abdominal segments (a: dorsal view; b: lateral view; c: ventral view). Scale bars: 1.0 mm for 12, 14; 4.0 mm for 13.

level  $M_2$  about 2.5 times as broad as discal spot and about 1.3 times as broad as apical area; posterior transparent area exceeding distal margin of discal spot.

**Hindwing.** Transparent; veins, discal spot and outer margin dark brown to black with dark purple sheen; discal spot small, cuneiform, reaching vein  $M_2$ ; outer margin narrow, slightly narrower than cilia; cilia dark brown with bronzed sheen, ochreous anally.

**Male genitalia** (genital preparation No. UIB 5519) (Figs 8a–d). Tegumen-uncus complex relatively broad; scopula androconialis well-developed, long, slightly longer than tegumen-uncus complex (Fig. 8a); crista gnathi medialis long, trapeziform, membranous proximally; crista gnathi lateralis long, semi-oval, slightly broader than crista gnathi medialis; valva (Fig. 8b) elongated trapeziform-oval; crista sacculi complicated; proximal part flat, short, not separated from sensory field of setae, covered with apically bifurcate setae; distal part pocket-shaped with a few strong, slightly bifurcate distally thorns; saccus (Fig. 8c) distinctly broadened basally with slightly bifurcate base, about as short as vinculum; aedeagus (Fig. 8d) narrow, slightly shorter than valva; without cornuti.

**Female genitalia** (genital preparation No. UIB 5518) (Figs 9a–b). Papilla analis relatively long, well-sclerotized, covered with short and long setae; 8th tergite relatively broad, with a few short setae; apophysis posterioris longer than apophysis anterioris; ostium bursae at middle of intersegmental membrane between segments 7 and 8, narrow, membranous; antrum relatively broad, well-sclerotized, long, about twice as short as apophysis anterioris; ductus bursae membranous, narrow, longer than anterior apophysis; corpus bursae ovoid with indistinct longitudinal signum.

**Mature larva** (Figs 4, 10–11)

Length: 13.2–18.0 mm. Head light brown; mouth parts dark brown. Body creamy white; prothoracic shield light yellowish brown, claws brown; anal shield light yellowish brown (Fig. 11e). Head (Fig. 11a) broader than long; coronal suture extremely short. Ocelli (Fig. 11b) six; ocelli V and VI separated from ocelli I–IV. Labrum (Fig. 11c) with its outer margin quite convex. Mandible (Fig. 11d) with three large and one small teeth. Spiracle of 8th abdominal segment located in dorsal area and rather near to posterior margin (Fig. 10). Proleg (Fig. 11h) with about 30 crochets. Anal proleg (Fig. 11i) with about 8 crochets.

**Chaetotaxy.** Head (Figs 11a–b): P1 very long, P2 microscopic. A1 very long and A3 long; A2 extremely short, adjacent to A1. O1 rather short, shorter than O2 and slightly anterodorsal to ocellus II. Prothorax (Fig. 11e) with an L group trisetose and arranged in triangle on large pinaculum, L1 very long. Abdomen (Figs 10, 12f–g) with SD1 very long, SD2 microscopic on 1st–7th segments. L1 of 1st–8th segments very long. SV group of 2nd–6th segments each on separate small pinaculum. L group of 8th segment very adjacent to large spiracle.

**Pupa** (Figs 12–14)

Length: 12.0 mm, width 3.0 mm. Brown, rather slender. Frontal process (Fig. 12) well developed, sharply pointed frontally in lateral view. Clypeus large, posteriorly triangular-trapezoid; maxillae very long, longer than fore legs. Mid legs and wing tips extending to 5th abdominal segment. Hind legs extending to 6th abdominal segment. Alar furrows on mesothoracic dorsum strongly enlarged and well ridged. Spines on dorsum of abdominal segment consisting of two rows on segments 2–7 in male and 2–6 in female; one row on segments 8–9 in male and 7 in female. Tenth abdominal segment (Fig. 14) with five pairs of spines; three pairs of large spines on dorsal-lateral side and two pairs of small spines on ventral side.



Material examined. 17 ♂ 14 ♀, Igok-ri, Buk-myeon, Kapyeong-gun, Korea, em. 8–29. VI. 1999 (Y. Arita, M. Ikeda & Y. S. Bae) on *Malus pumila* var. *dulcissima* Koidzumi.

Host-plants. *Malus pumila* var. *dulcissima* Koidzumi (Rosaceae).

Distribution. Korea (Gyunggi Province); China.

Bionomics. Univoltine. The larva lives between the bark and the wood of *Malus pumila* var. *dulcissima* Koidzumi (Rosaceae). Before pupation it forms a cocoon constructed of rounded sawdust.

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## 摘 要

韓国のリンゴを加害する *Synanthedon haitangvora* Yang (鱗翅類, スカシバガ科) の成虫と幼虫の分類学的な研究 (李 哲敏・有田 豊・裴 良燮)

韓国で栽培リンゴを加害するスカシバガが発見され、その種は *Synanthedon unocingulata* Bartel, 1912

と誤って同定されていた。今回の調査で、雌雄ゲニタリアが異なることに気付き詳しく調べた結果、中国からカイドウの一種やセイヨウリンゴを加害するものとして記載された *S. haitangvora* Yang, 1977 であった。本報告では成虫、雌雄ゲニタリア、幼虫、蛹などの形態と簡単な生態を記載した。生活史は近縁種である日本産のコスカシバ *S. hector* (Butler) 同様に栽培リンゴの樹皮下にもぐって加害する。韓国で調査したリンゴ園での発生は少なかった。

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